framatome

# COBRA-FLX ADVANCED CODE

## Thermal-hydraulic Analyses for PWR

## Licensing support and margin gain through detailed simulation of core and fuel assembly thermal-hydraulics

### Challenge

Safe and economic operation of nuclear power plants is highly dependent on the accuracy and flexibility of the applied codes and methods. These codes need to be very performant to realize 3D steady-state and transient full core analyses in reasonable computing time, like COBRA-FLX™ does.

COBRA-FLX is the global thermal-hydraulic analysis and design code of Framatome. As such, it is the thermal-hydraulic module of the core simulator ARTEMIS™ within the ARCADIA® code system.

### Solution

COBRA-FLX determines in detail the thermal-hydraulic behavior of fuel assemblies in the core of pressurized water reactors (PWR). Thus, operational and safety-related analyses can be performed with high accuracy for homogeneous and mixed cores. Coupling to other core simulators than ARTEMIS™ is possible, as well as including other fuel rod modules or chemical codes.
Among others, the following applications are available:

- Reload analyses for a variety of fuel assembly designs; for that numerous critical heat flux (CHF) correlations are implemented
- Lift force calculation for steady-state conditions
- Crud risk assessment
- Steaming rate prediction

A user-friendly environment facilitates the application of COBRA-FLX for various power plant and fuel assembly designs.

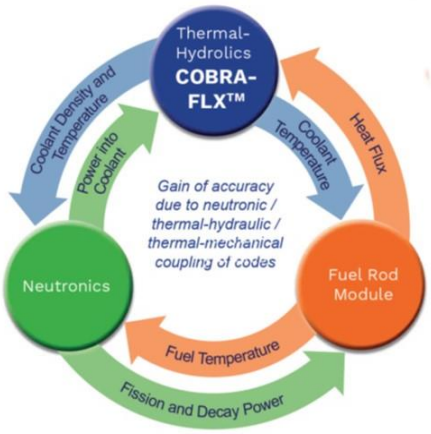


Fig 1: Calculation scheme and interaction ith other codes.

### Customer benefits

- Gain of margins through coupled neutronic/thermal-hydraulic/thermal mechanical methods
- Fast pin-by-pin full core transient calculations
- Licensing support for PWR core and fuel assembly design and accident analyses
- Reload analyses for a variety of fuel assembly designs
- Improved crud risk assessment
- User-friendly and flexible core generation tool
- Easy coupling to other codes due to defined interface routines
- Worldwide accepted for nuclear reactor licensing (U.S. NRC approval since 2013)

**Your performance**
is **our** everyday **commitment**

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## Technical Information

COBRA-FLX evaluation capabilities
- 3D distributions of coolant flow and temperature in the core
- Steady-state and transient subchannel analysis of fuel assemblies and reactor core
- Low and even reverse flow modelling capability

Subchannel-by-subchannel DNB analyses
- Integration in the Framatome Core Simulator ARTEMIS™
- Full core pin and sub-channel wise steady-state and transient neutronic and thermal-hydraulic evaluations
- Fuel and cladding temperature distributions based on ARTEMIS™ fuel rod module

Well-defined interface routines
- Easy coupling to other codes

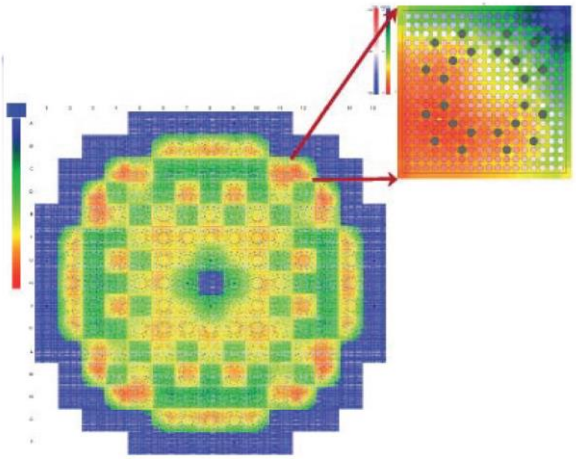

Fig 2: Visualization of a COBRA-FLX calculation of a full reactor core with pin-by-pin resolution

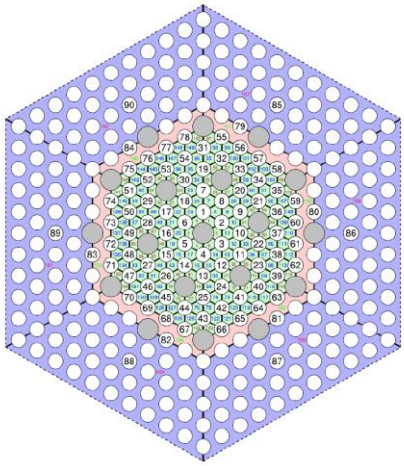

Fig 3 : Example of VVER-1000 fuel assembly nodalization for us with COBRA-FLX

## References

- COBRA-FLX is used for business support to customers in USA, France, Germany and other countries.
- U.S. NRC Approval received in January 2013, see Topical Report ANP-10311NP-A.

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